Expanding on-orbit care

Human patient simulation can help train flight surgeons, astronauts for medical emergencies

By Andrew Zehr

Thanks to a computer-connected, lifelike mannequin known as the Human Patient Simulator (HPS), NASA astronauts and flight surgeons have a chance to make and learn from mistakes before they ever reach space.

"Wouldn't it be nice if life had a rewind button? If you mess up you could stop what you were doing, rewind and try it again," said Dr. Kira Bacal, NASA Medical Informatics and Health Care Systems (MIHCS). "That is what the HPS allows us to do."

The HPS fulfills NASA's need for an efficient way to train crew members for the host of medical emergencies that could occur in space.

The HPS, which was developed as an offshoot of flight simulator technology, consists of a lifelike high-fidelity mannequin that can breathe, have a pulse, open its eyes and be given any emergency drug necessary to treat or correct a medical condition. These mannequins are manufactured by Medical Education Technologies, Inc., and are currently used in medical schools and allied health programs around the world to train health care professionals.

The technology's versatility persuaded NASA to adopt the HPS for training medical flight control teams – including flight surgeons, biomedical engineers and crew medical officer astronauts – for medical emergencies on International Space Station and Space Shuttle missions.

Dr. Hal Doerr, the principal investigator of NASA's Medical Operational Support Team (MOST), said the simulator can mimic 30 different patients with 40-50 medical scenarios that feel very realistic to those in training.

"We can simulate various patients that range from a young, healthy 22-year-old active non-smoking male up to a 90-year-old, less-active diabetic female," said Doerr, who is also the head of the Houston Center for Advanced Patient Simulation at Baylor College of Medicine. "There are over 200 physiological combinations we can work with."

The MOST is a joint multi-specialty project of the National Space Biomedical Research Institute, MIHCS and Wyle Laboratories. Doerr said that collaboration between these organizations works well because members of the groups have worked together previously on space medicine projects and are able to combine and learn from their previous experiences.

The MOST uses the simulator's physiological possibilities to program "patients" that mimic the altered physiology of astronauts either during or after a flight. Doing so enables medical flight control teams to have a hands-on platform to practice management of medical conditions either on orbit or within 24 hours of return.

To maximize the utility of the HPS, NASA can also use it to evaluate medical hardware.

"It has multiple functions," said Dr. Victor Hurst IV, MIHCS Project Scientist with Wyle Laboratories and a member of the MOST. "We're expanding on-orbit health care by developing, testing and validating medical equipment and procedures with the HPS."

Although these products have been thoroughly tested on Earth, there is no guarantee that they will handle the same in space. Sending medical hardware into space can be expensive and dangerous; the HPS can minimize the risk by duplicating how a patient in space might react during a medical emergency.

"If MIHCS needs to evaluate the commercial, off-the-shelf ventilator they are modifying for use aboard the ISS, they can use the HPS as a test bed to see how it would function in a simulated space environment," Hurst said.

Minimizing the danger of testing new products in hazardous situations is a priority not only for NASA but for a variety of groups. Doerr has used patient simulators to train nurses, respiratory therapists, pharmacists, firefighters and military personnel. They are also used to prepare for situations that occur away from a health care network.

"The HPS allows education to be the focus of attention rather than the patient," Bacal said. "High-fidelity human patient simulation allows participants to learn from their mistakes until they are confident in their skills."

By using human patient simulation, the MOST expects to provide the NASA community with hands-on exposure to space-relevant medical scenarios. In doing so, the MOST anticipates this project will have an impact on present and short-term medical projects, including medical training, and facilitate long-term planning for expanding space medical care for future long-duration missions.

Medical Operational Support Team members work on the Human Patient Simulator. From left are Dr. Victor Hurst IV, Dr. Hal Doerr and Dr. Kira Bacal.

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